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# Improvement of hearing after myringotomy with tympanostomy tube insertion in young patients with otitis media with effusion

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## ABSTRACT

The aim of this study is to explore the hearing improvement after MTT and evaluate the operation outcome in terms of the postoperative complications and hearing improvement stated by the patients. *Methods:* A hospital based cross-sectional study was conducted in Hail General Hospital in Hail, Saudi Arabia, during the period from 1 June to 31 Septemper, 2020. *Results:* In most of cases (96.7%), there was hearing improvement after MTT. Postoperative complications were only 3.3% of tympanic holes and the same number of postoperative bleeding, but 14.4% had transient secretions or fluids after surgery and 4.4% of patients had blood, mucus or other The tube was clogged with secretions. 11.1% of patients have a damaged or weakened eardrum. *Conclusion:* In most cases (96.7%), our study showed improvement in hearing after MTT. The most common postoperative complications were transient.

**Keywords:** hearing, myringotomy, tympanostomy, tube insertion, otitis media with effusion

## 1. INTRODUCTION

A myringotomy is a tympanic membrane incision to allow middle ear ventilation, fluid drainage, or cultures to be collected from an infection in the middle ear. This procedure can be combined with placement of tympanostomy tube. For children with middle-ear effusions, initial care frequently requires examination or antibiotic therapy while recent research has shown that antibiotics support otitis media with effusion as well as acute otitis media is limited (Lous, 2008). The most common ambulatory procedure performed on children is myringotomy with ventilation tube placement (Cullen et al., 2009). Tympanostomy, followed by mastoidectomy, are the utmost commonly accomplished major ear operations on children (Siegel & Chi, 2015). Otitis Media with Effusion (OME) can be defined as the condition

where the middle ear cleft is inflamed with collected liquid in the mid ear and an intact tympanic membrane. It can be acute or chronic (Zernotti et al., 2017).

Though the placement of tubes is not curative, severity and chronicity of middle ear diseases that indicate the placement of the tube are usually associated with the child having episodes of fluid collection and inflammation (Hellstrom et al., 2011). The 3 most common risks associated with myringotomy with tympanostomy tube insertion (MTT) are postoperative otorrhea, persistent tympanic membrane perforation, and tympanosclerosis. Hearing loss is a rare complication. Therefore, the risk of hearing loss is discussed with any patient who is about to undergo MTT, as well as other possible complications (Barati et al., 2012). Although the possibility of hearing impairment is commonly considered theoretical for MTT, many otolaryngologists regularly conduct preoperative and postoperative audiometric tests to record the preoperative hearing condition of the patient and if it has improved or not (Master et al., 2018).

Tympanostomy tube placement in children having chronic middle ear effusion yields better average hearing thresholds (compared with watchful waiting) at a period of 1 to 3 months postoperative (the period when most tubes are functioning). The outcomes are that the mean hearing thresholds are improved by ~10 dB after MTT in addition to or without adenoidectomy when assessed 1 to 3 months postoperative (Dale et al., 2018). Many factors can influence the effectiveness of myringotomy with tympanostomy tubes in cases of OME (chronic otitis media with effusion) as well as the recurrent AOM (acute otitis media). These factors are the same factors that affect the prognosis for diseases of the middle ear in children and they include age, age at first diagnosis, day care exposure and frequency of respiratory tract infections (Rosa-Olivares et al., 2015; Martines et al., 2011). A retrospective study on 96 adults and 130 children with otitis media, both groups were treated with CO2 laser myringotomy. The study showed a near 50% cure rate at six months in both groups (Martines et al., 2011).

A study aimed to guide the timing of postoperative audiograms reported that; the patients that were assessed by sound field audiometry showed a mean preoperative value of 29.2 dB. This was improved to 21 dB after 2 weeks after the operation and 17.9 dB after 6 to 10 weeks postoperative. The study concluded that the variance amid the two (mean±SD) of the postoperative values was highly significant ($P < 0.0001$). On the other hand, the patients that were evaluated using pure-tone audiometry, had a mean air-bone gap of 20.1 dB preoperative, which was improved to 10 dB and 7.3 dB at the first and second postoperative visits, respectively. The pre- and postoperative means had a highly significant difference ($P<0.0001$). For the patient subgroups who had an adjunct adenotonsillectomy, the grander enhancement at the late follow-up was also statistically significant (Chang et al., 2012).

A previous study conducted to compare the outcome of myringotomy alone with myringotomy and tympanostomy tube (grommet) in OME in terms of improvement in hearing and tympanogram pattern. Of the 60 patients, 39 were male and 21 were female. Ages ranged from 5 to 15 years and the average age was 8 years. The first group showed 48% improvement in hearing and tympanogram pattern after 2 weeks, 55% after 1 month, and 62% after 3 months. In the second group, there was an improvement of 67% after 2 weeks, 84 after 1 month, and 95 after 3 months. One patient (3%) developed conservatively treated postoperative otorrhea (Hu et al., 2015).

### Aim of the Study

The aim of this study is to explore the hearing improvement after MTT and assess the operation outcome in terms of the postoperative complications and hearing improvement reported by the patients.

## 2. METHODS & PARTICIPANTS

### Study design and setting

A hospital based cross-sectional study was carried out in Hail General Hospital in Hail, Saudi Arabia, during the period from 1 June to 31 September, 2020.

### Data source

90 patients who underwent myringotomy with tympanostomy tube insertion were included in this study and their medical records were reviewed and a pre-designed questionnaire was used to collect data. The questionnaires included questions about age, gender, type of feeding in first two years of life, exposure to passive smoking, hearing loss, recurrent AOM, recurrent visits to ENT clinic. The questionnaires include also questions about previous middle ear infection with fluid behind the tympanic membrane, previous incision of the tympanic membrane performed and tubes placed in the ear, if yes, purpose of the operation, whether there is impairment of hearing before the operation, degree of hearing impairment, the types of complications after operation if any and hearing improved after the operation and percentage of improvement.

**Data management and Statistical analysis**

The collected data entered then was analyzed using the Statistical Package for the Social Science (SPSS Inc. Chicago, IL, USA) version 23. Descriptive statistics was performed. Percentages were given for qualitative variables. Chi-square test was used to determine the determinant factors and we stated the P-value significant if ($P< 0.05$).

**Ethical considerations**

Approval was obtained by the Research Ethics Committee from Hail University with letter number (Nr. 5336/5/42). Data was anonymous for patient confidentiality. Use of these anonymous data in this research project was reviewed and approved by the research ethics committee. The collected data was kept safely in a password protected computer.

## 3. RESULTS

Table 1 shows the sociodemographic data of the participants. We found that 52.2% were less than 10 years oldwhile 47.8% were more than 10 years old. We found that the majority (63.8%) were males and the type of the breast feeding in the first two years of life were both of bottle feeding and breast feeding in 41.9%. The number of members in the family was more than 5-7 members in 67.7%. The academic performance level of the patient's (child) was good in 83.8% of the patients. Table 2 illustrates the risk factors and comorbidities of the patients. We found that most of patients (75.2%) had middle ear infection with fluid behind the tympanic membrane. All the patients have myringotomy with placing tubes. The commonest reason for myringotomy with TTI is fluid behind the tympanic membrane (figure 1). 62.2% of the patients removed the tonsils during the operation. There is an obvious impairment of hearing before the operation in more than 91.1% of the patients and 94.4% of the patients had improvement in hearing after the operation.

**Table 1** Sociodemographic characteristics of participants (n=90)

| Parameter | | No. | Percent |
|---|---|---|---|
| Age (years) | Less than 10 | 47 | 52.2 |
| | 10 – 1 9 | 43 | 47.8 |
| Gender | Male | 56 | 63.8 |
| | Female | 34 | 36.2 |
| Type of breastfeeding in the first two years of life | bottle feeding | 40 | 38.1 |
| | Breast feeding | 13 | 20.0 |
| | both of them | 37 | 41.9 |
| Number of members in the family | 2-4 | 19 | 21.1 |
| | 5-7 | 61 | 67.7 |
| | >7 | 10 | 11.1 |
| The patient's (child) academic performance level | Good | 74 | 83.8 |
| | Weak | 16 | 16.2 |
| Family member or others smoke near the child | Yes | 65 | 25.7 |
| | No | 25 | 74.3 |

**Table 2** Risk factors and comorbidities of tympanostomy (n=90)

| Parameter | | No. | Percent |
|---|---|---|---|
| Previous middle ear infection with fluid behind the tympanic membrane | Yes | 15 | 75.2 |
| | No | 75 | 24.8 |
| Indications of the MTT operation | regeneration of air inside the ear | *12* | *13.3* |
| | Fluid behind tympanic membrane | *71* | *78.8* |
| | middle ear air pressure regulator | *7* | *7.8* |
| The adenoids removed with the operation of ear tubes | Yes | *79* | *87.8* |
| | No | 11 | 12.2 |
| The tonsils removed with ear tubes | Yes | 56 | 62.2 |

| | | | |
|---|---|---|---|
| | No | 34 | 37.8 |
| There is an obvious impairment of hearing before the operation | Yes | 82 | 91.1 |
| | No | 8 | 8.9 |
| Degree of hearing impairment | Slim | 20 | 22.2 |
| | medium | 48 | 53.3 |
| | High | 22 | 24.4 |
| If hearing improved after the operation | Yes | 85 | 94.4 |
| | No | 5 | 5.6 |
| Percentage of improvement, if any | Slim | 5.6 | 5.6 |
| | medium | 14.4 | 14.4 |
| | High | 80.0 | 78.9 |

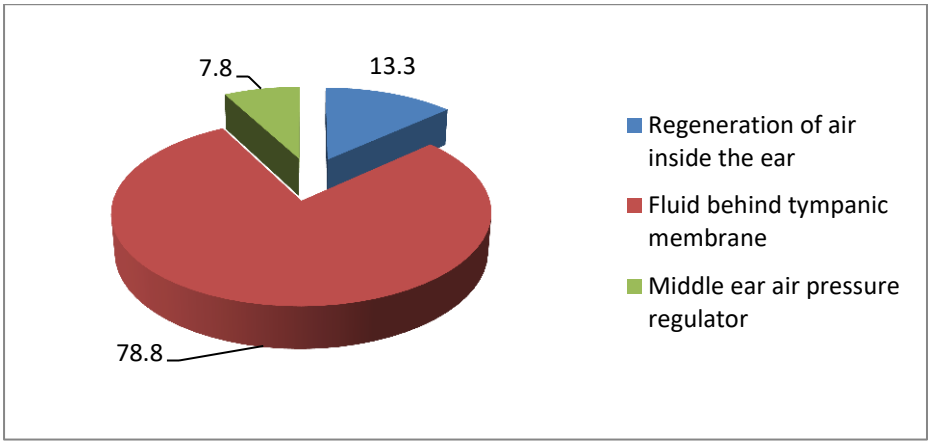


**Figure 1** Indications of the MTT operation among the studied cases

Table 3 shows the complications after operation. We found that only 3.3% had a hole in the tympanic membrane; the same number had bleeding after the operation, only 14.4% suffered from temporary secretions or fluids after the operation. We found that in 4.4% of patients' tubes become clogged with any secretions like blood or mucus after the operation and only 11.1% of patients had scarring of the drum after the operation as a complication. Table 4 shows the relation between loss of hearing before the operation and each of age, sex and type of breastfeeding in the first two years of life. We found insignificant correlation between loss of hearing before the operation and each of age, gender and breastfeeding type (P>0.05).

**Table 3** The complications after operation (N=90)

| Parameter | | No. | Percent |
|---|---|---|---|
| Occurrence of complications such as a hole in the tympanic membrane | Yes | 3 | 3.3 |
| | No | 87 | 96.7 |
| Bleeding after the operation | Yes | 3 | 3.3 |
| | No | 87 | 96.7 |
| Suffered from secretions or fluids after the operation | Yes | 13 | 14.4 |
| | No | 77 | 85.6 |
| The tubes become clogged with secretions after the operation | Yes | 4 | 4.4 |
| | No | 86 | 95.6 |
| Scarring of the eardrum after the operation | Yes | 10 | 11.1 |
| | No | 80 | 88.9 |
| Tubes fallen out too early? Less than three months | Yes | 9 | 10 |
| | No | 81 | 90 |
| Tubes staying inside for a very long time after the operation, more than two years | Yes | 8 | 8.9 |
| | No | 82 | 90.1 |

| | | | |
|---|---|---|---|
| Ear tubes fall out spontaneously | Yes | 77 | 85.6 |
| | No | 13 | 14.4 |
| Tubes removed by the doctor in the clinic | Yes | 18 | 20.0 |
| | No | 72 | 80.0 |
| The ear protected from water entering after the operation | Yes | 83 | 94.4 |
| | No | 7 | 7.7 |
| The ear fluid return again and the tubes were placed more than once | Yes | 14 | 15.6 |
| | No | 76 | 84.4 |

**Table 4** The relation between loss of hearing before the operation and each of age, sex and type of breastfeeding in the first two years of life of the studied children (N=90)

| | | Loss of hearing before the operation | | Total (N=90) | P value |
|---|---|---|---|---|---|
| | | No | Yeas | | |
| Age (years) | Less than 10 | 3 | 44 | 47 | 0.472 |
| | | 37.5% | 53.7% | 52.2% | |
| | 10-19 | 5 | 38 | 43 | |
| | | 62.5% | 46.3% | 47.8% | |
| Gender | Female | 4 | 30 | 34 | 0.445 |
| | | 50.0% | 36.6% | 37.8% | |
| | Male | 4 | 52 | 56 | |
| | | 50.0% | 63.4% | 62.2% | |
| Type of breastfeeding in the first two years of life | Bottle feeding | 4 | 36 | 40 | 0.946 |
| | | 50.0% | 43.9% | 44.4% | |
| | Breast feeding | 1 | 12 | 13 | |
| | | 12.5% | 14.6% | 14.4% | |
| | Both of them | 3 | 34 | 37 | |
| | | 37.5% | 41.5% | 41.1% | |

## 4. DISCUSSION

The MTT is a small tube that is implanted into the eardrum to retain the middle ear ventilated for long periods of time and prevent water from accumulating in the middle ear. The operation to insert the tube involves a myringotomyand is performed under local or general anesthesia (Venekamp et al., 2016; Ashar, 2018). Study shows a lower incidence of complications and sequelae than in the literature, particularly regarding otorrhea. The factor that contributed to the reduced incidence was adenoidectomy at the same time as the patient's age at the time of initial tube placement. The current study was hospital based cross-sectional study was carried out in Hail General Hospital, aimed to explore the hearing improvement after MTT and assess the operation outcome in terms of the postoperative complications and hearing improvement reported by the patients.

In the present study, more than half (52.2%) were less than 10 years and most (78.8%) of all patients had the operation for purpose of discharging of secretions from the middle ear, there was obvious impairment of hearing in 24.4% of cases and 87.8% of the patients removed the adenoid during the operation. Another published study reported that most cases of OME present between 1 to 6 years of age. OME can lead to many complications, e.g., hearing loss (HL), impaired tympanic membrane movement, and negatively impact the quality of life (Robb & Williamson, 2012). Candidates for myringotomy and Grommet insertion (MGI) include children with OME lasting more than 3 months, with persistent HL, recurrent or persistent OME in children at risk regardless of hearing status, like patients with syndromes, and OME with structural damage to the tympanic membraneor middle ear (Simon et al., 2018). The hearing recovers from 6 - 12 dB when tubes are patent. Adenoidectomy is recommended for those who have recurrent OME, unless contraindicated, because adenoidectomy decreases the recurrent rate of OME by 50%5. Grommet tube (GT) insertion results in a mean of 62% relative decrease in effusion prevalence (Blanc et al., 2018).

In our study, we included a sample of 90 patients who had MTT operation. More than half (63.8%) of our participants were males. Similarly, some other studies have reported a male preponderance (Hu et al., 2015). In contrary to a previous study done in

Assiut city, Egypt (Mohamed et al., 2021), the researchers included a study sample of 100 patients underwent treatment of recurrent SOM, 52% of them were females. Also, similarly, Nshimirimana et al., (2018) conducted a cross-sectional survey at a tertiary teaching hospital in Rwanda in ENT Department during the study period. This study enrolled 109 patients, of whom 59% were females.

In our study 75.2% of the cases had previous middle ear infection with fluid behind the tympanic membrane and most (81.1%) of patients had the operation for purpose of discharging of middle ear secretions. In another study, the most important indicationof the surgical treatment was discharge from the ear and damage of the middle ear contents (Gates et al., 2019). There is an obvious impairment of hearing before the operation in more than 90% of the patients and 96.7% of the patients had improvement in hearing after the operation. Another published study reported benefits based on subjective and objective improvements in patients' hearing. Placement of a tympanostomy tube in children with chronic middle ear effusion gives better average hearing thresholds compared to the expectation of 1 to 3 months after surgery. As a result, the mean hearing threshold improves by 10 dB after tube insertion, assessed 1-3 months after surgery (Dale et al., 2017). Also, Adkins (2005) in his study concluded that, the overwhelming majority of patients who undergo surgical removal of tubes will show complete tympanic membrane healing.

Regarding the complications, 3.3% had a hole in the tympanic membrane; the same number had bleeding after the operation, only 14.4% suffered from temporary secretions or fluids after the operation. We found that in 4.4% of patients' tubes become clogged with any secretions after the operation and only 11.1% of patients had scarring or weakening of the eardrum. Ragab et al., (2015) stated that, early complications were observed in 42 ears. The most common was early otorrhea, early extrusion, delayed complications were found in 74 ears; plugged tubes and recurrence of effusion. Another study reported the most common postoperative complication is a hole in the tympanic membrane, bleeding after operation, fluids and secretions in the ear and tubes become clogged with any secretions after the operation. All these complications affect the outcome of the operation and hearing strength in the patient (Ashar, 2018).

In our study patients had the operation for middle ear air pressure regulation in 7.8% in additional study; the overall complication rate after location of pressure equalization tube is about 11% (Simon et al., 2018). In our study the tubes staying inside for a very long time after the operation, more than two years in 8.9% and in 85.6% of cases the tubes fall out spontaneously. These results were in line with Moon et al., (2013), who reported that tympanostomy tubes, if removed 12 months ago, it has been shown to be more likely to recur and asymptomatically reserved tympanostomy tubes are suggested to eliminate when a tube is reserved for >18 months.

In the current study the ear fluid returns again and the tubes were placed more than once in 15.6%. After the Eustachian tube has been extruded, children should regularly check for recurrence of OME because there is high recurrence rate (Yaman et al., 2010).

## 5. CONCLUSION

Based on our study, in most of cases (96.7%), there was hearing improvement after MTT. Postoperative complications were, temporary secretions or fluids after the operation, scarring of the eardrum, the tubes become clogged with any ear secretions, presence of a hole in the tympanic membrane and bleeding after the operation.

**Author Contributions**

All the authors contributed evenly with regards to data collecting, analysis, drafting and proofreading the final draft.

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This study has not received any external funding.

**Conflict of Interest**

The authors declare that there are no conflicts of interests.

**Data and materials availability**

All data associated with this study are presented in the paper.

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